

TABLE OF CONTENTS

	Page
4.1 PURPOSE.....	3
4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION	3
4.2.1 Safety Equipment - Portable GFCI Cord Sets	3
4.2.2 Safety Equipment - Personal Light Source (Flashlight)	3
4.2.3 Lockout/Tagout Procedures.....	3
4.2.4 General Mechanical Inspection	3
4.2.5 General Mechanical Maintenance	3
4.2.6 Fastener Inspections.....	4
4.2.7 Electrical Insulation Resistance Tests	4
4.3 HOW THIS SECTION IS STRUCTURED	4
4.4 MECHANICAL EQUIPMENT.....	4
4.4.1 Hydraulic Pump	5
4.4.2 Hydraulic Ram.....	6
4.4.3 Saddles and Cable Socket.....	8
4.4.4 Steel Members in Anchorage Assembly.....	9
4.4.5 Port Cover.....	9
4.4.6 Cable Tension Adjustment	10
4.4.7 Bilge Piping System.....	12
4.4.8 Bilge Pumps.....	12
4.5 PONTOON EXTERIOR – ELECTRICAL ITEMS.....	14
4.5.1 Incoming Service Medium Voltage Switchgear	14
4.5.2 Photoelectric Cell Controller.....	15
4.5.3 Navigation Lights	16
4.5.4 Dupline Control System Panel.....	17
4.5.5 Remote Monitoring and Control Panel.....	19
4.5.6 Electrical Conductors	20
4.5.7 Sidewalk Lights	20
4.5.8 Weather Monitoring Station	21
4.5.9 Motorist Aid Telephone System.....	22
4.6 PONTOON INTERIOR – ELECTRICAL ITEMS.....	22

4.6.1	Medium Voltage Fuses	22
4.6.2	Medium Voltage Transformers.....	23
4.6.3	P1 Panels – Power Distribution Panel	24
4.6.4	P2 Panels – Pontoon Lighting Panel.....	25
4.6.5	P3 Panels – Control System.....	27
4.6.6	P4 Panels – Control System.....	28
4.6.7	P5 Panels - Water Sensor Monitoring	30
4.6.8	Cathodic Protection System.....	32
4.6.9	Water Sensors	34
4.6.10	Smoke Detector System.....	34
4.6.11	Pontoon Lighting System.....	35
4.6.12	Pontoon Receptacle System.....	36
4.6.13	Intercom Communication System.....	36
4.6.14	Electrical Conductors	37

4.1 PURPOSE

This section describes maintenance inspections of the bridge's mechanical and electrical items. Inspections assess the condition of the bridge and identify deficiencies. Maintenance guidelines are set up for periodic cleaning, adjustment, or servicing of specific items. For each item, the frequency of maintenance is based on recommendations by the manufacturers and guidelines established by the Mercer Island Bridge Crew and Bridge Preservation Office. Inspection and maintenance forms are provided in Section 6. All maintenance activities are to be recorded and all inspection and maintenance forms are to be maintained by the Northwest Region Bridge Office.

4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION

4.2.1 Safety Equipment - Portable GFCI Cord Sets

Portable power cords with Ground Fault Circuit Interrupting protection are provided in MIBS. All persons using portable electrical equipment in the pontoons shall use the portable power cord sets. The cord sets are plugged in the wall or ceiling mounted receptacle and the electrical equipment is then connected to the power cord set. The power cord set will protect the user from electrical shorts related to working in wet or damp environments that the existing power panel is not equipped to prevent.

4.2.2 Safety Equipment - Personal Light Source (Flashlight)

All persons entering or working in the pontoon should be equipped with an emergency flashlight or similar light source. In the event of a power outage, the pontoons do not have battery powered back up lighting to illuminate the safe path for egress from the pontoon.

4.2.3 Lockout/Tagout Procedures

No electrical apparatus or electrically driven apparatus should be worked on while energized. The appropriate circuit breakers or disconnect handles for the equipment being worked on shall be locked in the open (off) position and tagged. The appropriate immediate upstream circuit breaker or protective device should always be used to electrically isolate the equipment. A sign should be posted at the control panel to identify that the devices are tagged out of service. A contact person shall be identified on the tag.

4.2.4 General Mechanical Inspection

When inspecting any mechanical bridge system, check for:

- Corrosion
- Wear
- Signs of yielding, including deformed metal and cracked paint
- Damage to concrete adjacent to mounting bolts
- Loose bolts

4.2.5 General Mechanical Maintenance

Whenever greasing a mechanism, attempt to put lubricant in the place where contact occurs in the most highly loaded position. Actuate or deactuate the mechanism while greasing it to allow grease to penetrate the contact area. It is best to unload the mechanism while greasing it. Wipe off excess grease.

4.2.6 Fastener Inspections

Visually check all fasteners for indication that any fastener may be loose. Look for cracked paint or gaps between the fastener components (bolt, washers, nut) and the mating parts. Be sure to look at all interfaces of the joint where the rotation should occur. Look for yielded or worn parts that could cause joint looseness. Look for damaged concrete that would allow an anchor bolt to pull out.

4.2.7 Electrical Insulation Resistance Tests

An insulation resistance or “Megger” test consists of applying a 500- or 1000- volt direct current potential across the insulation of the item under test, using an instrument made for this purpose. A reading will be shown in the thousand or millions of ohms. If the procedure does not specify whether the 500- or 1000- volt direct current potential setting should be used, use the 500 volt direct current potential setting.

4.3 HOW THIS SECTION IS STRUCTURED

This inspection and maintenance section is divided into subsections that group items by type and location. Each subsection describes an item, the number of such items, location, inspection procedures, and/or the maintenance frequency and procedures. Photo references are included where applicable. Section 6 Inspection and Maintenance Forms are identified for the specific item.

4.4 MECHANICAL EQUIPMENT

The mechanical equipment on the Homer Hadley Bridge includes the cable anchorage assemblies and the bilge piping system. These are among the most important items associated with floating bridges.

Each pontoon is anchored to the lake bottom by at least two 2-3/8 in. diameter steel cables. These cables hold the bridge in a straight alignment and resist all horizontal forces exerted on the structure by wind and wave action. The typical cable is oriented perpendicular to the bridge, and averages somewhere between 400 ft. and 600 ft. in length. The cables enter the pontoons 1.5 feet below water and are only faintly visible from the bridge deck. There are additional cables attached to pontoon J. These cables are called longitudinal cables since they are oriented along the length of the bridge. Their purpose is to provide support to the entire structure in the east/west direction.

The cable connects to the pontoon at the cable anchorage assembly. The purpose of the cable anchorage assembly is to hold the cable securely in position, without slip, which in turn holds the pontoon in a fixed position. The cable sag allows for some horizontal and vertical movement of the pontoons.

A cable anchorage assembly includes a saddle, steel plates, port, socket, cable crosshead, anchorage wall, and a cable tension adjustment device. The cable adjustment device consists of a threaded steel rod, jacking and cable crossheads, hydraulic ram, hydraulic pump, and heater.

The cable enters the pontoon through the port, passes over the saddle, and connects to a socket. This marks the end of the cable. The socket is connected to the cable crosshead, which bears against several steel plates that are bolted into the anchorage wall. It is at this point that the cable tension force is transferred to the pontoon, or conversely, that the pontoon motion is resisted by the cables.

A port cover reduces the amount of water that might spill into the pontoon interior. A neoprene gasket is used as a seal between the cover and the concrete. The cable passes through an unsealed hole in the center of the cover.

The bilge piping system is used to remove water from the pontoons in the event of a severe water leak. It

consists of bilge piping in the interior of the pontoons, bilge pumping ports on the pontoon exterior, and bilge pumps.

4.4.1 Hydraulic Pump

Description

The hydraulic pump is part of the anchor cable tension adjustment device. The pump supplies pressure to the ram, which in turn pulls the cable. At the proper cable tension, adjustment shims at the cable crosshead are freed, and either additional shims can be added or existing shims can be removed. Upon completion of the shim adjustment, the pressure in the pump is released, and the cable forces are transferred from the jacking crosshead back to the cable crosshead.

The electric powered hydraulic pump is controlled by a small hand held switch unit. The pump forces hydraulic fluid to the cylinder, thereby serving as the ram's power source. The pump is small and easily handled by one person. A hydraulic gauge measures the ram's output force in tons.

Hydraulic pump:

OTC, SPX CORP
Hydraulic Pump Model A
10,000 psi
½ HP
115 V
3450 RPM
7.6 Amp

Refer to photo numbered 5-18.

Number of Items & Location

In pontoons A and R, there is one pump for each anchorage assembly. In all other pontoons, there is one hydraulic pump per pair of transverse anchorage assemblies in the bridge. In a typical pontoon, the anchorage assembly is in the center of the pontoon. In addition, pontoon J has one pump for each of its twelve longitudinal cables. Thus, there are a total of 36 hydraulic pumps.

Inspection Procedure (Use Form 6-7)

- ☐ Look for leaking of hydraulic oil (check level).
- ☐ Check for correct calibration.
- ☐ Check for proper response and movement of the needle.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION. Repairs and maintenance should be performed in a dust-free area by a qualified technician.

Annually (Use Form 6-7)

- ☐ Perform calibration procedures.
- ☐ Remove and clean all dirt, dust, oil or any other foreign material from outer surface.
- ☐ Ensure that all unused couplers are sealed with thread protectors.
- ☐ Remove and clean dirt and grime from hose connections.
- ☐ Ensure that the breather-hole in the filler cap is clean and unobstructed.
- ☐ Clean all equipment connected to the pump.

5 Years (Use Form 6-17)

- ☐ Change the oil. Use Mobil DTE25 hydraulic oil, 150 VG46

4.4.2 Hydraulic Ram

Description

The hydraulic ram is also part of the anchor cable tension adjustment device. The ram is the mechanical component that pulls the cable. The pulling action increases the tension in the cable and transfers the cable force from the cable crosshead to the jacking crosshead. Once the cable crosshead is free, the shims can be removed, or additional shims can be installed. Removing shims will cause the final tension force in the cable to relax, and adding shims will increase the final tension force. The desirable cable tension is 65 tons.

The hydraulic ram is capable of producing up to 150 tons of force. A single threaded 2-3/4 in. rod extends through the ram center. The rod is connected to the ram at one end by a large hex nut. At the opposite end the rod connects to the cable crosshead. The crosshead is attached to the cable via a socket and large pin.

The ram is powered by the electric hydraulic pump. An inlet hose and an outlet hose for the fluid extend between the ram and the pump.

Electric heaters, which are operated during cold weather, are placed next to the hydraulic rams. They provide added moisture protection to the anchorage assembly. The heaters are 120 Volts and 750 Watts.

Refer to photo numbered 5-19.

Number of Items & Location

There is one hydraulic ram in each anchorage assembly in the bridge. In a typical pontoon, there are two anchorage assemblies in the center of the pontoon. Since there are 52 anchorage assemblies in the bridge, there are also 52 hydraulic rams. A heater is placed adjacent to each hydraulic ram.

Inspection Procedure (Use Form 6-7)

Each year all anchor cables are visited at least four times – twice as the lake level increases in the Spring, and twice as the lake level decreases in the Autumn. Therefore, normal use of the jacks provides ample opportunity to assess their working condition.

Prior to using the ram, a visual inspection for damage to the cylinder or piston is required. Also, use this time to check for leaking hydraulic fluid, loose bolts, and loose hose connections.

If the ram is not being used, the piston should be left in the retracted position. If a piston has been left in the extended position, then it must be lubricated (wiped with an oil wet cloth) prior to use.

- ☐ Check for corrosion or cracks on housing.
- ☐ Check for leaking hydraulic fluid.
- ☐ Look for loose bolts.
- ☐ Check for nicks in piston rod.
- ☐ Check for loose hose connections.

Maintenance Schedule and Procedures**Annually (Use Form 6-7)**

- ☐ Clean and re-lubricate any exposed threads. Spray with CRC Industrial 3-36 Multipurpose Lubricant and Corrosion Inhibitor.
- ☐ Clean all exposed surfaces, especially hose connections, of dust, grime, or grit.
- ☐ Check for hydraulic fluid leaks.
- ☐ Check for improperly functioning swivel heads and caps.
- ☐ Check for improperly assembled, modified or altered accessory equipment.
- ☐ Check that couplers that are not being used are sealed with thread protectors.

CAUTION:

- ☐ Any ram or cylinder found to be in need of repair must be clearly tagged and not used until all repairs are complete.

- ☐ Because hard particles that settle on the piston can scratch the interior of the cylinder, the piston should be left in its retracted position after each use.

Note: The double acting cylinders are designed to be maintenance-free; it is not necessary to replace the seals, or service the cylinder interior on a routine basis. See “trouble-shooting cylinders” in manufacture specs if the ram is not working properly, or for additional information.

4.4.3 Saddles and Cable Socket

Description

Saddles provide a smooth vertical support for the anchor cable inside the pontoon. The cable rides over the saddle, is redirected into a horizontal position, and then is connected to the socket. This marks the end of the cable. Greasing is required to ensure minimal friction between the cable and the saddle during cable retensioning operations.

The saddle is cast-steel with a machined curved body. The anchor cable is supported in a trough with a 1-3/16 in. radius. A near frictionless fabric called Poly-Tetra-Fluoro-Ethylene (PTFE) is bonded to the bottom face of the saddle. This allows the whole saddle to easily slide on the bearing plate. The bearing plate is capped with a stainless steel plate.

Refer to photos numbered 5-20 and 5-21.

Number of Items & Location

There is one saddle in each anchorage assembly. The typical pontoon has two anchorage assemblies— one on the north side and one on the south side, both located near the pontoon’s mid-section. The exceptions are the center and end pontoons, which have additional anchors. Pontoons A and R each have four anchorage assemblies, and pontoon J has fourteen. Twelve of the anchors in pontoons J are sharply skewed to provide longitudinal stability to the bridge. Thus, there are 52 saddles on the bridge.

Inspection Procedure (Use Form 6-7)

- ☐ Look for corrosion or cracks in metal.
- ☐ Look for cracks or rust stains in concrete.
- ☐ Check condition of cable in saddle.
- ☐ Check condition of grease.
- ☐ Check for splaying or corrosion of wires at connection to cable socket.

Maintenance Schedule and Procedures

Annually (Use Form 6-7)

- ☐ Use grease gun to apply grease into tap fittings. Use Chevron Ultra-Duty Grease EP NLGI 2.

4.4.4 Steel Members in Anchorage Assembly

Description

The concrete anchorage wall is reinforced with steel channels in areas of high stress. The other steel members in the anchorage assembly are the cable crosshead, the jacking crosshead, the threaded rod, the hex nut at the ram, the bearing plates, adjustment track, and the shims.

Refer to photos numbered 5-19 and 5-20.

Number of Items & Location

The steel members are located at each anchorage location. There are two anchorage locations per typical pontoon, four per end pontoon, and fourteen locations in pontoon J.

Inspection Procedure (Use Form 6-7)

- ☐ Inspect the adjustment track, cable crosshead, and the jacking crosshead. Look for corrosion, cracks in welds and castings, and paint deterioration.
- ☐ Inspect the steel tension rod and the hex nut at the ram. Look for excessive wear, bending, or damage to the threads. Check for rust and cracks.
- ☐ Inspect the bearing plates and shims. Look for corrosion, cracks, plate or bolt movement, and loose bolts.

Maintenance Schedule and Procedures

Annually (Use Form 6-7)

- ☐ Spot paint the metal areas where deterioration of the paint cover is occurring. In areas where the paint is cracked, peeling, or there is evidence of corrosion, remove all loose materials by scraping or wire brush, prior to application of primer and new paint. Clean and paint at least two inches beyond the limits of the deteriorated areas.

5 Years (Use Form 6-17)

- ☐ Re-paint all metal surfaces. Remove existing rust, dirt, grime, or any other material that would inhibit adhesion of the new paint, prior to application.

CAUTION: Paint removal and application procedures should conform to the pertinent regulations for confined spaces. Use masks and ventilation as required, and as recommended by the safety procedures (see Section 1.9).

4.4.5 Port Cover

Description

The port cover provides a water seal at the inside port of the anchor cable tunnel. Because the outside port hole is an open hole and is located below the lake water level, water is able to enter the tunnel to an elevation equal to the lake level. During periods of rough water, the lake water travels to the top of the tunnel where it comes into contact with the port cover. It is possible for lake water to actually spill into the pontoon by passing

through a central hole cut into the port cover to allow passage of the anchor cable.

There are two types of port covers on the bridge. One type is $\frac{3}{4}$ in. thick, square, marine plywood, with a $\frac{1}{4}$ x $\frac{1}{4}$ in. neoprene gasket attached along the inside perimeter of the plywood for sealing action. The other type is similar, but is made of a hard plastic material.

Refer to photo numbered 5-21.

Number of Items & Location

There is one port cover in each anchorage assembly. In a typical pontoon, two anchorage assemblies are located near the pontoon's mid-section. Since there are 52 anchorage assemblies in the bridge, there are also 52 port covers.

Inspection Procedure (Use Form 6-7)

- ☐ Look for evidence of water leakage.
- ☐ Look for deterioration of the seal.
- ☐ Look for deterioration or cracks of the plywood cover.

Maintenance Schedule and Procedures

5 Years (Use Form 6-17)

- ☐ Replace the marine plywood cover with the hard plastic cover as needed.
- ☐ Replace the gasket as needed.

4.4.6 Cable Tension Adjustment

Description

The water level in Lake Washington is controlled by the retention or release of water from the Ballard locks. These locks are operated by the U.S. Army Corps of Engineers.

All anchor cables on the floating bridge require tension adjustments twice a year due to seasonal fluctuations of Lake Washington's water level. These adjustments normally occur during April and November. A touch-up adjustment generally follows approximately one month later to compensate for the carry-over effects that the tightening or relaxation operation of individual cables have on each other, and for the continuing effect of water level changes.

The cable tension adjustment is performed inside the pontoon at the pontoon anchorage assembly. Each cable is equipped with a permanent hydraulic ram and hydraulic pump (with a gage) that are used to mechanically increase or decrease the cable tension. The desired cable tension, as measured on the pump gage, is 65 tons. This tension does not account for cable friction at the saddles or wind acting on the bridge. Consequently, it is recommended that cable tension adjustments not be performed during windy periods. The pump gage can be read in pressure (psi) or force (tons). The working range for cable tension is 50 to 70 tons.

The Cable Tension Adjustment Form (Form 6-6) must be filled out during the tension adjustment operations. This form is included at the end of Section 6, following the inspection forms. Completed copies of the forms

are to be forwarded to the Bridge Preservation Office, in Olympia, after the final fall and spring adjustments.

Refer to photos numbered, 5-18, 5-19, 5-20, and 5-21.

Maintenance Schedule and Procedures

6 Months (Use Form 6-6)

1. Check the cable tension. To do this, put tension on the cable and record the reading on the hydraulic pump gage at the point when the shims start to become loose on both sides of the cable.
2. Re-set the shims. Remove or install the necessary number of shims to achieve the desired tension. Increase cable tension as necessary. Record the number of shims removed or installed. Do not release tension.
3. Record new cable tension. After the shim adjustments are complete, record the cable tension. It should be +/- 2 tons from the desired tension (65 tons).
4. Release cable tension. Slowly relieve the hydraulic pressure.
5. Check new cable tension. Repeat cable adjustment steps if necessary.
6. Return in approximately one month to recheck cable tensions. This check is used to fine tune the initial adjustments. Repeat tension adjustment steps as necessary for all cables that are not at the desired tension, +/- 2 tons.

Notes:

- ☐ The cable tensioning operation should begin with the transverse cables. After all transverse cables are adjusted, repeat the above steps for all longitudinal cables.
- ☐ Throughout the cable tension adjustment operations, perform visual checks on bridge alignment. Stop all operations immediately if unusual alignments of successive pontoons begins to occur, and determine cause of excessive alignment changes.
- ☐ The lake rises during the spring months, causing the cable tension to increase. Thus, shims are normally removed at this time of year.
- ☐ The lake falls during the autumn months, causing the cable tension to decrease. Thus, shims are normally added at this time of year.
- ☐ In the spring period, the lake level will start to rise in February, reach mid-point at about the end of March, and achieve its high elevation around the beginning of May. Spring cable re-tensioning operations normally start at the beginning of April. Usually, by the first of May it is necessary to remove additional shims.
- ☐ In the autumn period, the lake level will start to fall in September, reach mid-point at about the end of October, and achieve its low elevation around the beginning of December. Fall cable re-tensioning operations normally start at the beginning of November. Usually, by the first of December it is necessary to add additional shims, which corresponds to step 6 above.
- ☐ During a normal year, the lake elevation varies roughly between 20 feet and 22 feet.

4.4.7 Bilge Piping System

Description

In the event of a severe water leak, pumps are used to remove water from pontoon cells through bilge piping. For the pump to draw water, the water depth must be more than six inches.

The bilge piping system consists of a group of three suction pipes, per group of five transverse cells, and the respective end connections for each pipe. The piping is 4 inch Sch. 80 PVC. The discharge end of each pipe is the bilge pumping port. It is a 4 in. standard stainless steel pipe that extends 3 ft. beyond the south exterior wall, beneath the cantilever section of the bridge. A stainless steel cam locking cap, a kamlok quick-disconnect fitting, is positioned at the pipe end. The cap must be removed prior to pumping. Thus, it is imperative that the cap be maintained in good condition so it can be easily removed in the event of an emergency.

When it is necessary to remove water from a cell, a pump is transferred to the area of the flooded cell(s). Flexible hoses are then connected between the discharge ends of the bilge pipes and the pump manifold. At this point the pumping operation can begin.

The source end of the pipe, the end through which the water enters the bilge pipe, is positioned vertically along the wall of the cell. The bottom of the pipe is cross shaped and rests on the slab floor. The reducer inlet is six inches above the floor.

Refer to photos numbered 5-3, 5-14, 5-22 and 5-23.

Number of Items & Locations

The bilge piping is located throughout the bridge. The source end of a pipe is typically positioned vertically along the south wall of cells A, C, and E in each pontoon. The bilge pumping ports are typically located along the outside face of the south pontoon walls. The exceptions are the pumping ports on the lower decks.

Inspection Procedure (Use Form 6-7, 6-8, 6-9, 6-12)

The bilge piping is a permanent fixture on the bridge. The purpose of the inspection is to identify evidence of cracks in the pipes, loose connections, or any defect that would cause a leak in the system.

- ☐ Visually inspect the entire pipe length. Look for cracks, corrosion, and evidence of leak potential.
- ☐ Inspect the reducer, flange coupling, and reducer bushing at the inlet of the pipe. Look for cracks, corrosion, evidence of leak potential, and debris.
- ☐ Inspect the bilge pumping ports. Look for cracks, corrosion, and evidence of leak potential.

4.4.8 Bilge Pumps

Description

When water needs to be removed from a cell, a pump is transferred either by the maintenance boat, or a trailer pulled by a truck, to the location of flooding. Flexible hosing connects the bilge pumping ports to the pumps. Then the pumps are used to remove the water from the pontoon. Three types of bilge pumps are used:

Grindex Pump:

Runs off of trailer mounted 50kW generator
(Generators are the responsibility of the Transportation Equipment Fund)

Godwin Bilge Pump (Orange):

KHD Deutz Engine

Model No. 8202714

27 kW

2800 RPM

Oil Filter: Car Quest 85342

Fuel filter: Car Quest 86159

Twelve 3 inch outlets, and one 4 inch outlet.

Power Prime Bilge Pump (Blue):

KHD Deutz Engine

Model No. 8456215

49 kW

Fuel Filter/Separator: Racor Parker R45T

Oil Filter: Car Quest 85768

Fuel filter: Car Quest 86358

Six 4 inch outlets, and one 6 inch outlet.

Refer to photo numbered 5-24.

Number of Items & Location

When a pump is in operation, it is normally mounted on a maintenance boat or a trailer pulled by a truck.

When the pumps are not in operation, they are stored in the following locations:

Location	Pump Type
H.H. West Lower Deck	One Godwin Pump
H.H. East Lower Deck	Four Grindex Pumps One Generator
L.V.M. West Lower Deck	One Godwin Pump
L.V.M. East Lower Deck	One Godwin Pump
Mercer Island Bridge Shop	One Godwin Pump

The pumps identified as Godwin Pumps may actually be Power Prime Pumps. Since the pumps are very similar and operated in the same manner, they are all referred to as Godwin Pumps.

Maintenance Schedule and Procedures**Monthly (Use Form 6-2)**

☐ Run pump for one hour.

Annually

The bilge pumps are owned by TEF. The following maintenance, as well as repair, will be performed by TEF.

- ☐ Change oil. Use 15-40 standard Diesel oil.
- ☐ Change fuel. Use Diesel fuel.

4.5 PONTOON EXTERIOR – ELECTRICAL ITEMS

4.5.1 Incoming Service Medium Voltage Switchgear

Description

The 15-kV incoming service medium voltage switchgear is the service entrance for power to the bridge. The switchgear is located at the west approach of the bridge, provided by Seattle City Light. There are two pairs of enclosed metallic medium voltage switchgear, with the Homer Hadley Bridge served by switch no. 1 of switchgear no. 2. While the switches themselves are not labeled, there are identification labels on the doors. The switch is identified on the one line drawing by the number “1A”, but in the field it is identified as “switchgear 2 switch 1”. The equipment is mounted on a concrete pad.

Refer to photo number 5-25.

Number of Items & Location

There is one switch that provides power to the Homer Hadley Bridge.

The directions for locating the medium voltage switchgear are:

- Take I-90 west (Homer Hadley Bridge) across Lake Washington
- Take the Rainier Avenue Exit 3B
- Turn right onto South Charles Street
- Follow South Charles Street across Davis Place South
- Turn right onto 20th Street South
- Follow 20th Street South across 23rd Street South
- Turn left onto 24th Street South
- Turn onto the next right, South Judkins Street
- Follow South Judkins Street – make a left on Bradner Place South and then a quick right back onto South Judkins Street
- Turn right on 33rd Avenue South
- Turn left onto South Irving Street
- Follow South Irving Street across Lake Washington Boulevard South
- At the intersection of South Irving Street and 35th Avenue South, there is a park entrance and bike ramp where the vehicle should be parked
- Follow the park walkway up to the switchgear area

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Only personnel trained in the operation and handling of medium voltage equipment should inspect, maintain,

or operate the equipment.

Annually (Use Form 6-14)

- ☐ Open the switch and inspect the interior for any damage or significant deterioration.
- ☐ Check for interior and exterior corrosion.

4.5.2 Photoelectric Cell Controller

Description

The navigation lights are controlled by a photoelectric controller located on a concrete pad adjacent to the medium voltage service switchgear. The photoelectric controller consists of a photoelectric cell that is wired to a control panel, and provides a signal to the dupline control system to energize the navigation lights. The photoelectric controller turns the navigation lights off during the day and on at night. The photoelectric controller is wired to a panel that contains electronic relays and controls.

The photo electric cell is protected by a wire cage. The control panel contains:

- A red pushbutton to energize all the navigation lights
- Two ice cube style relays
- A terminal strip for wiring
- Six electronic sensors and relays

Refer to photo number 5-26.

Number of Items & Location

There is one photoelectric cell connected to a control panel.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-14)

- ☐ Remove accumulation of dirt, grease, and gum with contact cleaner. Lightly lubricate contacts with silicone grease.
- ☐ Check for corrosion and moisture.
- ☐ Check for worn or broken mechanical parts.
- ☐ Check Relay Contacts:

- Discolored connections on terminals, contact supports, bus bars, or connectors usually indicate that overheating has occurred, probably because of loose connections. Clean connection points that are discolored. Tighten all hardware. Replace or repair heat damaged wire and connectors.
- ☐ Insulating Parts:
- Remove dust and dirt from insulating parts.
 - If carbonized tracks or cracked or broken insulators are found, replace the defective parts.
- ☐ Check Relay Operation:
- A humming sound emanating from the coil may indicate loose mounting.
 - Test the relay under power and check for abnormal noise and arcing, both on opening and on closing. A loud noise and arcing on closing is usually due to contact bounce.
- ☐ Clean the wire protection around the photoelectric cell. Verify that it is operating properly by turning the navigation lights on and off at dusk and dawn.

4.5.3 Navigation Lights

Description

Navigation lights are located on the outside faces of the columns on the elevated structures and the north face of the Homer Hadley Bridge pontoons. The function of the navigation lights is to assist boaters in locating the navigational openings under the transition span, and to make the bridges more visible during dark, foggy, or inclement weather conditions.

Red navigation lights are used to indicate obstructions to boaters.

Green channel marker navigation lights are used to indicate navigation openings under the transition spans. The green channel marker navigation lights are mounted on a rotating mount that allows the technician to pull the chain attached to the lamp, and rotate the lamp to sidewalk level. The green navigation lights have a dual lamp transfer relay and indicating light on the top of the support. When one of the two lamps fail, the indicating light illuminates to let the technician know to replace the bulb.

Refer to photos numbered 5-13 and 5-27

Number of Items & Location

There is one green navigation light at the east channel navigational opening. There is one green navigation light at the west channel navigational opening.

There is one red navigation light on each of Pontoons A through R, for a total of 18 red navigation lights on the pontoons.

There are nine red navigation lights on the columns supporting the elevated structures.

Maintenance Schedule and Procedures**WARNING**

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Weekly (Use Form 6-2)

- ☐ Check navigation lights to confirm proper operation.
- ☐ Replace lamps or fixtures, as needed.

Annually (Use Form 6-14)

- ☐ Clean globes, interior surface, and weep holes.
- ☐ Check gaskets.
- ☐ Tighten loose connections.
- ☐ Inspect for corrosion of metal parts.
- ☐ Replace worn or broken mechanical parts.

4.5.4 Dupline Control System Panel**Description**

The dupline control system panel is located in the basement of the Mercer Island Bridge Shop under the east approach. It monitors the adjacent Lacey V. Murrow Bridge as well as the Homer Hadley Bridge. It is powered by a 3-kVA uninterruptible power supply, allowing for uninterrupted monitoring of the pontoons should there be a power failure, although a power failure in a pontoon places that pontoon into an alarm condition. The UPS provides sufficient power to sound the alarm and activate the auto-dialer should power be lost to the bridge.

The dupline control system panel has two sections. One section contains the electronic sensors and relays, terminals, power supplies, and associated equipment used to monitor the pontoon equipment for the Homer Hadley Bridge. This equipment communicates with the P4 panels and P5 panels in the pontoons over the dupline communication cable. There are also bypass switches for all alarm functions to permit maintenance to be performed without triggering the auto-dialer to respond, but still display alarms on the Remote Monitoring and Control Panel.

The other section has intercom equipment and auto-dialer equipment. The auto-dialer will report alarm conditions that last longer than 5 minutes to a central monitoring station. The maintenance electricians have installed bypass switches for all alarm functions to permit maintenance to be performed without triggering the auto-dialer to respond, but still display alarms on the Remote Monitoring and Control Panel.

Refer to photos numbered 5-28, 5-29, 5-30 and 5-31.

Number of Items & Location

There is one dupline control system panel located in the basement of the Mercer Island Bridge Shop.

Maintenance Schedule and Procedures**WARNING**

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to **Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.**

Weekly (Use Form 6-3)

- ☐ Check UPS alarm indicators on control panel.

Annually (Use Form 6-14)

- ☐ Open enclosure and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Check for corrosion and moisture.
- ☐ Check for excess heating of parts, discoloration of metal parts, charred insulation, odor, or blistering.
- ☐ Tighten loose connections.
- ☐ Check for worn or broken mechanical parts.
- ☐ Lubricate door hinges and latches.
- ☐ Lightly lubricate contacts with silicone grease.
- ☐ Check Relay Contacts:
 - Discolored connections on terminals, contact supports, bus bars, or connectors usually indicate that overheating has occurred, probably because of loose connections. Clean connection points that are discolored. Tighten all hardware. Replace or repair heat damaged wire and connectors.
- ☐ Check Relay Operation:
 - A humming sound emanating from the coil may indicate loose mounting.
 - Test the relay under power and check for abnormal noise and arcing, both on opening and on closing. A loud noise and arcing on closing is usually due to contact bounce.

5 Years (Use Form 6-18)

- ☐ Perform battery test on the UPS in accordance with the manufacturer's manual. Change batteries, as needed.

4.5.5 Remote Monitoring and Control Panel

Description

The Remote Monitoring and Control Panel is located on the upper floor of the Mercer Island Bridge Shop. This panel serves as the alarm center and operation center for both the Homer Hadley and the Lacey V. Murrow Bridges.

The Remote Monitoring and Control Panel monitors the pontoons to determine the status of each pontoon and the control system. The Remote Monitoring and Control Panel:

- ☐ Indicates whether the pontoon interior cell lighting is energized
- ☐ Remotely de-energizes the interior cell lighting
- ☐ Indicates whether a pontoon P1 Panel breaker fault alarm has been activated
- ☐ Indicates whether a pontoon transformer high temperature alarm has been activated
- ☐ Indicates whether a pontoon smoke alarm has been activated
- ☐ Indicates whether a water level alarm has been activated
- ☐ Remotely energizes/de-energizes the navigation lighting
- ☐ Indicates whether a bypass switch has been activated

Refer to photo number 5-28.

Number of Items & Location

There is one Remote Monitoring and Control Panel on the upper floor of the Mercer Island Bridge Shop.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-14)

- ☐ Verify all indicating lights are working and replace as necessary.
- ☐ Open enclosure and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Check for corrosion and moisture.

- ☐ Check for excess heating of parts, discoloration of metal parts, charred insulation, odor, or blistering.
- ☐ Tighten loose connections.
- ☐ Check for worn or broken mechanical parts.
- ☐ Lubricate door hinges and latches.

4.5.6 Electrical Conductors

Description

Conductors may be stranded single-conductor or multiple-conductor cable.

Number of Items & Location

Numerous electrical conductors are located throughout the bridge.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Three Years (Use Form 6-16)

- ☐ Insulation test incoming service conductors. Isolate conductors from all other equipment before testing. Perform 500 volts DC insulation resistance megohm meter (Megger) testing. Perform test on each phase to ground and phase to phase.

4.5.7 Sidewalk Lights

Description

There are sidewalk lights mounted in the concrete barrier adjacent to the sidewalk. The sidewalk lights provide the necessary illumination to allow safe pedestrian traffic during the hours between sunset and sunrise.

Walkway lights consist of 50-watt high pressure sodium luminaries recessed in the concrete barrier and spaced along the walkway. All lamps are 240VAC lamps.

Refer to photo number 5-32.

Number of Items & Location

There are 98 luminaries located approximately 2 feet above the walkway surface and approximately every 59 feet along the walkway, recessed in the concrete barrier.

Maintenance Schedule and Procedures**WARNING**

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 **GENERAL INSPECTION AND MAINTENANCE INFORMATION**.

Weekly (Use Form 6-2)

- ☐ Check sidewalk lights to confirm proper operation, replace lamps as they burn out.

Annually (Use Form 6-14)

- ☐ Replace lamps or fixtures, as needed.
- ☐ Clean globes, interior surface, and weep holes.
- ☐ Check gaskets.
- ☐ Tighten loose connections.
- ☐ Inspect for corrosion of metal parts.

4.5.8 Weather Monitoring Station**Description**

There is a weather monitoring station located on the south side of Pontoon J. The monitoring equipment will provide immediate weather data regarding the wind speed, duration and direction, precipitation, air temperature, and humidity.

Refer to photo number 5-35.

Number of Items & Location

One weather station is located on the south side of Pontoon J.

Maintenance Schedule and Procedures**WARNING**

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 **GENERAL INSPECTION AND MAINTENANCE INFORMATION**.

Annually

- ☐ Remove weather monitoring equipment and send to Coastal Environmental Systems for recalibration.

4.5.9 Motorist Aid Telephone System

Description

Motorist aid telephone call boxes are located on the bridge and are available for motorist use.

Refer to photo number 5-34.

Number of Items & Location

Numerous motorist aid telephone call boxes are located throughout the bridge.

Maintenance Schedule and Procedures

The motorist aid telephone system is maintained by others.

4.6 PONTOON INTERIOR – ELECTRICAL ITEMS

4.6.1 Medium Voltage Fuses

Description

A fuse is an overcurrent protective device. Fuses protect the electrical equipment only one time, and then must be replaced with a new fuse. Fuses are cylindrical in shape and are fastened in place at the ends by fuse clips or ferrules.

Load break elbows are electrical connections that can be pulled apart with the correct insulated equipment to isolate equipment from power.

All the equipment in the cell is designed to be submersible.

Refer to photo number 5-36.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
Fuses Q1 and Q2, and 3 Load Break Elbows	B	B-7E	Fuses Q1 and Q2, and 4 Load Break Elbows	K	K-6E
Fuses Q1 and Q2, and 7 Load Break Elbows	E	E-7E	Fuses Q1 and Q2, and 4 Load Break Elbows	N	N-6E
Fuses Q1 and Q2, and 4 Load Break Elbows	H	H-6E	Fuses Q1 and Q2, and 3 Load Break Elbows	Q	Q-7E

Maintenance Schedule and Procedures

WARNING

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to **Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION**.

Only personnel trained in the operation and handling of medium voltage equipment should inspect, maintain, or operate the equipment.

Annually (Use Form 6-13)

- ☐ Check for corrosion and moisture.
- ☐ Remove accumulation of dirt, debris, and dust.
- ☐ Check for loose fittings or damaged insulation.
- ☐ Examine bus bar and cable connections for poor or loose connections and evidence of overheating.
- ☐ All high voltage connections should be scanned using a thermal scanner to detect heating caused by loose connections, and recorded on a video tape. These video images should be compared to images taken in previous inspections to determine trends or changes in thermal patterns.

4.6.2 Medium Voltage Transformers

Description

Transformers change the distribution voltage of 14.76kV to the utilization voltage of the bridges, 120/240V. Each transformer is 37.5kVA, single phase.

Each transformer is equipped with a temperature thermal sensor to provide an alarm when the transformer internal temperature rises above a preset level.

Refer to photo number 5-36.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
Transformers T2 and T3	B	B-7E	Transformers T2 and T3	K	K-6E
Transformers T2 and T3	E	E-7E	Transformers T2 and T3	N	N-6E
Transformers T2 and T3	H	H-6E	Transformers T2 and T3	Q	Q-7E

Maintenance Schedule and Procedures**WARNING**

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to **Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.**

Only personnel trained in the operation and handling of medium voltage equipment should inspect, maintain, or operate the equipment.

Annually (Use Form 6-13)

- ☐ Check for corrosion and moisture.
- ☐ Remove accumulation of dirt, debris, and dust.
- ☐ Check for loose fittings or damaged insulation.
- ☐ Examine bus bar and cable connections for poor or loose connections and evidence of overheating.
- ☐ All high voltage connections should be scanned using a thermal scanner to detect heating caused by loose connections, and recorded on a video tape. These video images should be compared to images taken in previous inspections to determine trends or changes in thermal patterns.

4.6.3 P1 Panels – Power Distribution Panel**Description**

P1 Panels are circuit breaker panels that distribute the 120/240VAC power from the transformer secondaries to the distribution P2 Panels for each pontoon. Each transformer has one P1 Panel, and each P1 Panel feeds power to two P2 Panels. Circuit breakers within the P1 Panels protect the P1 Panels and the feeders to the P2 Panels.

Panel boards are assemblies of bus bars and main/branch circuit breakers. The circuit breakers provide over-current protection as well as a means of turning on and off electrical distribution circuits.

Refer to photo number 5-37.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
P1	B	B-7E	P1	K	K-6E
P1	E	E-7E	P1	N	N-6E
P1	H	H-6E	P1	Q	Q-7E

Maintenance Schedule and Procedures**WARNING**

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to **Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION**.

Annually (Use Form 6-13)

- ☐ Open and clean with a vacuum cleaner.
- ☐ Remove accumulation of dirt, grease, and gum with contact cleaner. Lightly lubricate contacts with silicone grease.
- ☐ Check for corrosion and moisture.
- ☐ Examine bus bar and cable connections for poor or loose connections and evidence of overheating.
- ☐ Lubricate door hinges and latches.
- ☐ Operate each circuit breaker to check proper operation.
- ☐ Measure resistance to ground at each panelboard using a clamp on ground impedance meter. Verify resistance is 25 ohms or less.
- ☐ Contacts:
 - Replace pitted or worn contacts if practical. Install and adjust per manufacturers' specifications, otherwise replace entire item.
 - When replacing contacts or other current-carrying parts, clean surfaces that are to be bolted together.
 - Check for excessive arcing.
 - Check condition of gaskets (for dust-tight or watertight units).

Three Years (Use Form 6-15)

- ☐ Perform megohm meter (Megger) testing of each bus bar and cable phase to phase and phase to ground.

4.6.4 P2 Panels – Pontoon Lighting Panel**Description**

Each pontoon has one P2 panel, a lighting panelboard that supplies the 120/240V power for the pontoon.

Lighting panels, also known as panelboards, are assemblies of bus bars and main/branch circuit breakers. The circuit breakers provide over-current protection as well as a means of turning on and off electrical distribution

circuits.

Refer to photo numbered 5-38.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
P2	A	A-4E	P2	J	J-6E
P2	B	B-7E	P2	K	K-6E
P2	C	C-7E	P2	L	L-6E
P2	D	D-7E	P2	M	M-6E
P2	E	E-7E	P2	N	N-6E
P2	F	F-6E	P2	O	O-6E
P2	G	G-6E	P2	P	P-7E
P2	H	H-6E	P2	Q	Q-7E
P2	I	I-6E	P2	R	R-2E

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Open and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Lightly lubricate contacts with silicone grease.
- ☐ Check for corrosion and moisture.
- ☐ Examine bus bar and cable connections for poor or loose connections and evidence of overheating.
- ☐ Lubricate door hinges and latches.
- ☐ Measure resistance to ground at each panelboard using a clamp on ground impedance meter. Verify

resistance is 25 ohms or less.

- ☐ Operate each circuit breaker to check proper operation.
 - When replacing circuit breakers, clean surfaces that are to be bolted together.
 - Check for arcing.

Three Years (Use Form 6-15)

- ☐ Perform megohm meter (Megger) testing of each bus bar and cable phase to phase and phase to ground.

4.6.5 P3 Panels – Control System

Description

Each Pontoon has one P3 panel that controls the pontoon lighting, the navigation lighting for the pontoon, and the motorist aid telephone system (MATS) lighting. Control is by use of contactors and latching relays operated from external control signals via the P4 and P5 panels, and local light switches.

Each panel contains multiple (generally 16) electronic sensors and electronic relays. The panel has five – 5A fuses and an equipment ground bar.

Refer to photo number 5-39.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
P3	A	A-4E	P3	J	J-6E
P3	B	B-7E	P3	K	K-6E
P3	C	C-7E	P3	L	L-6E
P3	D	D-7E	P3	M	M-6E
P3	E	E-7E	P3	N	N-6E
P3	F	F-6E	P3	O	O-6E
P3	G	G-6E	P3	P	P-7E
P3	H	H-6E	P3	Q	Q-7E
P3	I	I-6E	P3	R	R-2E

Maintenance Schedule and Procedures**WARNING**

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Open enclosure and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Check for corrosion and moisture.
- ☐ Check for excess heating of parts, discoloration of metal parts, charred insulation, odor, or blistering.
- ☐ Tighten loose connections.
- ☐ Check for worn or broken mechanical parts.
- ☐ Lubricate door hinges and latches.
- ☐ Lightly lubricate contacts with silicone grease.
- ☐ Check Relay Contacts:
 - Discolored connections on terminals, contact supports, bus bars, or connectors usually indicate that overheating has occurred, probably because of loose connections. Clean connection points that are discolored. Tighten all hardware. Replace or repair heat damaged wire and connectors.
- ☐ Check Relay Operation and replace if necessary due to:
 - A humming sound emanating from the coil may indicate loose mounting.
 - Test the relay under power and check for abnormal noise and arcing, both on opening and on closing. A loud noise and arcing on closing is usually due to contact bounce.
- ☐ Inspect fuses for evidence of overheating and corrosion.
- ☐ Inspect fuse clips for dirt and verify that the clips provide a tight fit.
- ☐ Replace fuses as necessary with a fuse of the same model or an approved replacement model, and the same rating as the damaged fuse. Check the fuse ratings as referenced in the maintenance manual diagrams.

4.6.6 P4 Panels – Control System**Description**

Each pontoon equipped with medium voltage transformers is equipped with a P4 panel. The P4 panel contains transmitter and receiver modules that communicate with the remote monitoring panels. The panel monitors

transformer temperature, smoke detectors, circuit breaker status, pontoon lighting, and navigation lights.

Each panel contains multiple (generally 16) electronic sensors and electronic relays. The panel has one – 5A fuse, terminal blocks, meters, and an equipment ground bar.

Refer to photo number 5-40.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
P4	B	B-7E	P4	K	K-6E
P4	E	E-7E	P4	N	N-6E
P4	H	H-6E	P4	Q	Q-7E

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Open enclosure and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Check for corrosion and moisture.
- ☐ Check for excess heating of parts, discoloration of metal parts, charred insulation, odor, or blistering.
- ☐ Tighten loose connections.
- ☐ Check for worn or broken mechanical parts.
- ☐ Lubricate door hinges and latches.
- ☐ Lightly lubricate contacts with silicone grease.
- ☐ Check Relay Contacts:
 - Discolored connections on terminals, contact supports, bus bars, or connectors usually indicate that overheating has occurred, probably because of loose connections. Clean connection points that are discolored. Tighten all hardware. Replace or repair heat damaged wire and connectors.
- ☐ Check Relay Operation:
 - A humming sound emanating from the coil may indicate loose mounting.

- Test the relay under power and check for abnormal noise and arcing, both on opening and on closing. A loud noise and arcing on closing is usually due to contact bounce.
- ☐ Inspect fuses for evidence of overheating and corrosion.
- ☐ Inspect fuse clips for dirt and verify that the clips provide a tight fit.
- ☐ Replace fuses as necessary with a fuse of the same model or an approved replacement model, and the same rating as the damaged fuse. Check the fuse ratings as referenced in the maintenance manual diagrams.

4.6.7 P5 Panels - Water Sensor Monitoring

Description

Each pontoon contains a P5 panel that monitors the water sensors for that pontoon. In pontoons that do not contain a P4 panel, the P5 panel also controls the navigation lighting.

Each panel contains multiple (generally 11) electronic sensors and electronic relays. The panel has two – 5A fuses, terminal blocks, power supply, front panel red LED indicating lights, and an equipment ground bar.

Refer to photo number 5-41.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
P5	A	A-4E	P5	J	J-6D
P5	B	B-7E	P5	K	K-6D
P5	C	C-7E	P5	L	L-6D
P5	D	D-7C	P5	M	M-6D
P5	E	E-7D	P5	N	N-6D
P5	F	F-6D	P5	O	O-6D
P5	G	G-6D	P5	P	P-7D
P5	H	H-6D	P5	Q	Q-7D
P5	I	I-6D	P5	R	R-2E

Maintenance Schedule and Procedures**WARNING**

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Open enclosure and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Check for corrosion and moisture.
- ☐ Check for excess heating of parts, discoloration of metal parts, charred insulation, odor, or blistering.
- ☐ Tighten loose connections.
- ☐ Check for worn or broken mechanical parts.
- ☐ Lubricate door hinges and latches.
- ☐ Lightly lubricate contacts with silicone grease.
- ☐ Check Relay Contacts:
 - Discolored connections on terminals, contact supports, bus bars, or connectors usually indicate that overheating has occurred, probably because of loose connections. Clean connection points that are discolored. Tighten all hardware. Replace or repair heat damaged wire and connectors.
- ☐ Check Relay Operation:
 - A humming sound emanating from the coil may indicate loose mounting.
 - Test the relay under power and check for abnormal noise and arcing, both on opening and on closing. A loud noise and arcing on closing is usually due to contact bounce.
- ☐ Inspect fuses for evidence of overheating and corrosion.
- ☐ Inspect fuse clips for dirt and verify that the clips provide a tight fit.
- ☐ Replace fuses as necessary with a fuse of the same model or an approved replacement model, and the same rating as the damaged fuse. Check the fuse ratings as referenced in the maintenance manual diagrams.
- ☐ Verify all indicating lights are working and replace as necessary.

4.6.8 Cathodic Protection System

Description

The steel anchor cables are susceptible to damage and deterioration. The primary form of deterioration is galvanic corrosion of the steel caused by a current flow between two dissimilar metals in an electrolyte such as water with natural salts. This results in a loss of material and eventually diminishes a cable's strength. A cathodic protection system is employed as a permanent galvanic corrosion resistance feature of each cable.

The cathodic protection system consists primarily of an anode and a rectifier. The rectifier includes a transformer that transforms the incoming voltage to the desired operating voltage. The rectifier then converts this AC power to DC. The rectifier is also used to adjust the DC voltage and/or current to the desired level. The negative pole of the rectifier is connected to the cable to be protected, making it cathodic (negative). The anode is a sacrificial metal, platinum plated copper, which is connected to the positive pole. The cathodic protection system forces the steel cable to be less positive in relationship to the earth, preventing current flow that causes the galvanic corrosion. The metal of the anode is sacrificed in place of the anchor cable.

Refer to photo number 5-42.

Number of Items & Location

Cathodic Protection Rectifier	Cable	Pontoon	Cell	Cathodic Protection Rectifier	Cable	Pontoon	Cell
Anw	Anw	A	A-2B	L3n	L3n	J	J-5A
Ane	Ane	A	A-4B	L3s	L3s	J	J-5E
Asw	Asw	A	A-2H	L4n	L4n	J	J-8A
Ase	Ase	A	A-4H	L4s	L4s	J	J-8E
Bn	Bn	B	B-7B	L5n	L5n	J	J-10A
Bs	Bs	B	B-7E	L5s	L5s	J	J-10E
Cn	Cn	C	C-7B	L6n	L6n	J	J-10A
Cs	Cs	C	C-7E	L6s	L6s	J	J-10E
Dn	Dn	D	D-7A	Kn	Kn	K	K-6A
Ds	Ds	D	D-7E	Ks	Ks	K	K-6E
En	En	E	E-7A	Ln	Ln	L	L-6A
Es	Es	E	E-7E	Ls	Ls	L	L-6E
Fn	Fn	F	F-6A	Mn	Mn	M	M-6A

Cathodic Protection Rectifier	Cable	Pontoon	Cell	Cathodic Protection Rectifier	Cable	Pontoon	Cell
Fs	Fs	F	F-6E	Ms	Ms	M	M-6E
Gn	Gn	G	G-6A	Nn	Nn	N	N-6B
Gs	Gs	G	G-6E	Ns	Ns	N	N-6E
Hn	Hn	H	H-6A	On	On	O	O-6B
Hs	Hs	H	H-6E	Os	Os	O	O-7D
In	In	I	I-6A	Pn	Pn	P	P-7B
Is	Is	I	I-6E	Ps	Ps	P	P-8D
Jn	Jn	J	J-6A	Qn	Qn	Q	Q-6B
Js	Js	J	J-6E	Qs	Qs	Q	Q-7D
L1n	L1n	J	J-3A	Rnw	Rnw	R	R-2B
L1s	L1s	J	J-3E	Rne	Rne	R	R-4B
L2n	L2n	J	J-3A	Rsw	Rsw	R	R-2H
L2s	L2s	J	J-3E	Rse	Rse	R	R-4H

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Monthly (Use Form 6-5A, 6-5B)

- ☐ Monitor the cathodic protection voltage and current on the log forms.

Annually (Use Forms 6-11, 6-12, 6-13)

- ☐ Open enclosure and clean with a vacuum cleaner. Remove accumulation of dirt, grease, and gum with contact cleaner.
- ☐ Check for corrosion and moisture.

- ☐ Check for excess heating of parts, discoloration of metal parts, charred insulation, odor, or blistering.
- ☐ Tighten loose connections.
- ☐ Check for worn or broken mechanical parts.
- ☐ Lubricate door hinges and latches.
- ☐ Inspect fuses for evidence of overheating and corrosion.
- ☐ Inspect fuse clips for dirt and verify that the clips provide a tight fit.
- ☐ Replace fuses as necessary with a fuse of the same model or an approved replacement model, and the same rating as the damaged fuse. Check the fuse ratings as referenced in the maintenance manual diagrams.
- ☐ Check cathodic protection conductors.
- ☐ Check pontoon exterior cathodic protection shields.

4.6.9 Water Sensors

Description

The purpose of the water sensor is to detect water leaking into a cell. The sensor alarm is activated when the water depth in a cell reaches six inches.

There are two types of water sensors: an optical water sensor and a float switch.

Refer to photos numbered 5-43 and 5-44.

Number of Items & Location

There is one water sensor in each cell in every pontoon.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Test each water sensor. Verify that the sensor is operating properly. If the sensor is not operating properly, replace the defective unit.

4.6.10 Smoke Detector System

Description

A smoke detector is provided in each cell equipped with transformers and mounted on the ceiling of the

pontoon cells. The smoke detector senses the presence of smoke and activates an alarm.

Refer to photo number 5-45.

Number of Items & Location

Panel	Pontoon	Cell	Panel	Pontoon	Cell
Smoke Detector	B	B-7E	Smoke Detector	K	K-6E
Smoke Detector	E	E-7E	Smoke Detector	N	N-6E
Smoke Detector	H	H-6E	Smoke Detector	Q	Q-7E

Maintenance Schedule and Procedures

WARNING

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Test each smoke detector with a canned smoke product. Verify that the detector is operating properly. If the detector is not operating properly, replace the defective unit.

4.6.11 Pontoon Lighting System

Description

Incandescent and high pressure sodium light fixtures are mounted throughout each pontoon. Lighting panels are located in the pontoons to power the lights. The lamps are 70 and 100 watt lamps at the various locations. All lamps operate at 120V.

Refer to photo number 5-36.

Number of Items & Location

There is a minimum of one light fixture in each pontoon cell, and some pontoon cells have multiple light fixtures.

Maintenance Schedule and Procedures

WARNING

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Monthly (Use Form 6-4)

- ☐ Check for burned-out lamps. Replace lamps or repair ballast as needed.

Annually (Use Form 6-13)

- ☐ Clean luminaire lenses, interior surfaces, and weep holes (where applicable).
- ☐ Check gaskets and replace as needed.
- ☐ Tighten loose connections.
- ☐ Inspect for corrosion of metal parts. Spot paint as necessary.
- ☐ Replace worn or broken parts.

4.6.12 Pontoon Receptacle System**Description**

Receptacles are provided as convenience outlets for plugging in tools, lights, etc., throughout the pontoons. Receptacles include 120V duplex receptacles, 120V twist-lock receptacles and 240V twist-lock receptacles.

Refer to photo number 5-46.

Number of Items & Location

There are multiple receptacles located throughout the pontoons.

Maintenance Schedule and Procedures**WARNING**

Use **EXTREME CARE** and **ALWAYS REMOVE POWER** from all pertinent electrical equipment before beginning maintenance. Refer to **Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.**

Annually (Use Form 6-13)

- ☐ Inspect receptacles for cleanliness and security.
- ☐ With a receptacle test device test receptacles for proper connection and positive ground. **DO NOT** use a GFCI capable tester on the receptacles since they are not equipped with ground fault current interrupters.

4.6.13 Intercom Communication System**Description**

An intercom system is provided throughout each pontoon. One handset is located in a panel in each pontoon, and multiple speakers and intercom jacks are provided throughout the pontoons. A portable handset can be jacked into any of the handset jacks. The intercom allows the user to talk to another pontoon, the Mercer Island

Bridge Shop, the adjacent Lacey V. Murrow Bridge, or TSMC, from either the handset or the portable headset.

Refer to photos numbered 5-47 and 5-48.

Number of Items & Location

There is one handset unit in each pontoon and multiple intercom jacks and speakers located through each pontoon.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Test the intercom handset and intercom jacks to verify they are working properly.
- ☐ Test each speaker to verify that the speakers work properly.
- ☐ Tighten loose connections.
- ☐ Inspect for corrosion of metal parts. Spot paint as necessary.
- ☐ Replace worn or broken parts.

4.6.14 Electrical Conductors

Description

Conductors may be stranded single-conductor or multiple-conductor cable.

Refer to photo number 5-50.

Number of Items & Location

Numerous electrical conductors are located throughout the bridge.

Maintenance Schedule and Procedures

WARNING

Use EXTREME CARE and ALWAYS REMOVE POWER from all pertinent electrical equipment before beginning maintenance. Refer to Section 4.2 GENERAL INSPECTION AND MAINTENANCE INFORMATION.

Annually (Use Form 6-13)

- ☐ Insulation test service conductors between the P1 and P2 panels. Isolate conductors from all other equipment before testing. Perform 500 volts DC insulation resistance megohm meter (Megger) testing. Perform test on each phase to ground and phase to phase.